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PATENT ABSTRACTS OF JAPAN

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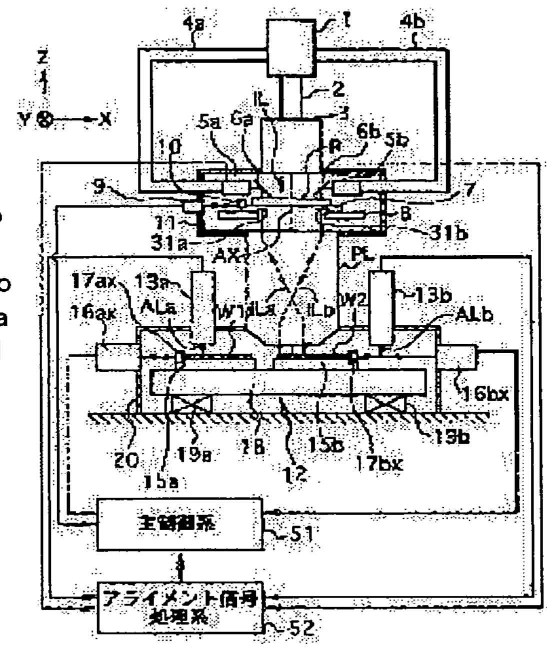
(54) METHOD OF EXPOSING, ALIGNER AND METHOD OF MANUFACTURING DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To shorten the preparatory time prior to the beginning of an exposure of a wafer to raise the productivity of the wafer in the case where the exposure is performed using a plurality of wafer stages and a plurality of alignment sensors.

SOLUTION: An aligner is constituted in such a structure that two wafer stages 15a and 15b are movably placed on a wafer base 18 to arrange two alignment sensors 13a and 13b in such a way as to hold a projection optical system PL for projecting the pattern of a reticle R between them and reticle alignment microscopes 5a and 5b for detecting a mark to be detected are arranged via the reticle R and the optical system PL over the reticle R. The position detection error between the sensors 13a and 13b is ready measured using the microscope 5a and when an exposure of a wafer is performed on the stage 15a (or 15b) on one side of the stages 15a and 15b, an alignment of the wafer is performed using the sensor 13b (or 13a) on the other stage 15b (or 15a).



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CLAIMS

[Claim(s)]
[Claim 1] Two or more 1st mark detection systems which are arranged by the exposure beam in a mutually different location, and detect the location of the mark on said body in the exposure approach which carries out sequential exposure of two or more bodies, respectively by it, The 1st process which prepares the 2nd mark detection system arranged in a different location from said two or more 1st mark detection systems, and searches for the location detection error of two or more of said 1st mark detection systems using said 2nd mark detection system, The 2nd process amended with the location detection error which detected the location of the mark on said two or more bodies using said two or more 1st mark detection systems, and searched for this detection result at said 1st process, The exposure approach characterized by having the 3rd process which carries out sequential exposure of said two or more bodies, performing alignment of the body of the sequential aforementioned plurality based on the positional information acquired at this 2nd process.
[Claim 2] The exposure approach according to claim 1 characterized by searching for the location detection error of two or more of said 1st mark detection systems in said 1st process using the body of a predetermined number from the head of two or more of said bodies.
[Claim 3] Two or more movable stages which position said body in the aligner which carries out sequential exposure of two or more bodies, respectively by the exposure beam, Two or more 1st mark detection systems which are arranged corresponding to said two or more movable stages, and detect the location of the mark on said body, respectively, The 2nd mark detection system arranged in a different location from said two or more 1st mark detection systems, The aligner characterized by having the operation system which searches for the location detection error of two or more of said 1st mark detection systems based on the detection result of said 2nd mark detection system, and amends the detection result of two or more of said 1st mark detection systems with this location detection error.
[Claim 4] The aligner according to claim 3 characterized by preparing two or more loader sections which detach and attach said body to said movable stage corresponding to each of two or more of said movable stages.
[Claim 5] Said two or more 1st mark detection systems are aligners according to claim 3 or 4 characterized by wavelength detecting a **-ed mark using light 500nm or more.
[Claim 6] They are claims 3 and 4 which have the common projection optics which carries out sequential exposure of the body on said two or more movable stages using the exposure beam which passed the mask, and are characterized by said 2nd mark detection system using said a part of projection optics [at least], or an aligner given in 5.
[Claim 7] Said 2nd mark detection system is an aligner according to claim 6 characterized by detecting the mark on said mask, and the mark on said body to coincidence through said projection optics.
[Claim 8] Said 2nd mark detection system is an aligner according to claim 6 or 7 characterized by detecting a **-ed mark using the light of the same wavelength substantially with said exposure beam.
[Claim 9] They are claims 3 and 4 characterized by having the common projection optics which carries out sequential exposure of the body on said two or more movable stages using the exposure beam which passed the mask, arranging said 2nd mark detection system near said projection optics, and detecting a **-ed mark through said projection optics, or an aligner given in 5.
[Claim 10] The device manufacture approach of having the process which imprints a device pattern on a

work piece using the exposure approach according to claim 1 or 2.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] a photolithography for this invention to manufacture various devices, such as a semiconductor device, image sensors (CCD etc.), a liquid crystal display component, or the thin film magnetic head, — it is in process and is related with the exposure approach and equipment which are used in order to imprint a mask pattern on a sensitization substrate.
[0002]
[Description of the Prior Art] At the photolithography process for forming the detailed pattern of electron devices, such as a semiconductor integrated circuit and a liquid crystal display, the approach of carrying out the contraction imprint of the patterns (or photo mask etc.) of the reticle as a mask which carried out proportionality expansion of the pattern which should be formed at about 4 to 5 times, and drew on the wafers (or glass plate etc.) as an exposed substrate using the projection aligner of an one-shot exposure method or a scan exposure method is used. For example, in manufacture of a semiconductor integrated circuit, since it is necessary to cover dozens of layers, to maintain position relation mutually, and to form a detailed pattern on a wafer, in case a pattern is imprinted to the layer after the two-layer eye on a wafer using a projection aligner, it is necessary to perform alignment (alignment) of the pattern currently formed in the layer under it, and the pattern to be exposed from now on with high precision.
[0003] For this reason, the projection aligner is equipped with the alignment sensor for the wafers for detecting correctly the location of the alignment mark (wafer mark) attached to each shot field on a wafer, and in a projection aligner, the exposure imprint of the pattern of a new reticle is carried out so that it may lap with the existing pattern currently formed in each shot field on a wafer correctly based on the detection result of that alignment sensor. The allowed value of the superposition error between two or more layers is still smaller, and a very high detection precision is required also of an alignment sensor as degrees of integration, such as a VLSI, improve.
[0004] FIA which forms the expansion image of a **-ed mark like a microscope, and detects the location of a **-ed mark using the image pick-up signal of the image although there are various kinds of detection methods in an alignment sensor (Field Image Alignment) As for an image pick-up method like a method, current is in use. as the illumination light (alignment light) for detecting a **-ed mark, in order not to expose the photoresist (sensitive material) applied on the wafer by the FIA method — the wavelength of 500nm or more — comparatively — a long wave — merit's light is used.
[0005]
[Problem(s) to be Solved by the Invention] The projection aligner is equipped with the highly precise alignment sensor for wafers in order to acquire a superposition precision high like the above. It not only raises superposition precision recently, but the demand to the improvement in a throughput (throughput) of a projection aligner does not know the place which remains with low-pricing of a semiconductor device etc. That is, the throughput of 100 or more per hour is once demanded for that whose throughput to a wafer with a diameter of 127mm was before and after 60 per hour from the wafer with a diameter of 200-300mm now.
[0006] In order to realize such a high throughput, it is desirable to prepare two stages (wafer stage) in which a wafer is laid mutually-independent in the condition which can be driven, and to process the wafer on two sets of wafer stages to juxtaposition as a double stage method at coincidence about exchange of

the wafer on a wafer stage, location detection of the alignment mark on a wafer, and a series of actuation called exposure of the pattern of the reticle of UEHAHE. Furthermore, in order to perform these actuation to juxtaposition more efficiently, it is more desirable to make it correspond to two sets of the above-mentioned wafer stages, and to also have two alignment sensors. By this, while exposing the wafer on one wafer stage directly under projection optics, exchange of the wafer on the wafer stage of another side and detection (alignment) of an alignment mark can be performed, and the large improvement in a throughput is attained.

[0007] However, when it has two alignment sensors by the double stage method in this way, the relative location detection error between both alignment sensors makes superposition precision (alignment precision) deteriorate. Although the superposition error which originates in an alignment sensor also conventionally existed, it was possible to have measured that error amount by performing test exposure, for example, and to have amended based on this measurement result. However, when the number of alignment sensors is two and a test exposure method is only applied, there is a possibility that the productivity as the whole process for manufacturing a semiconductor device etc. may not improve so much even if the setup time which the test exposure which uses both sensors is needed, and is needed before initiation of actual exposure increases and the throughput at the time of exposure improves.

[0008] When exposing in view of this point using two or more movable stages which position the body for exposure, respectively, and two or more mark detection systems (alignment sensor) corresponding to this, this invention can shorten the setup time before exposure initiation, and aims at offering the exposure technique in which devices, such as a semiconductor device, can be manufactured for productivity high as a whole.

[0009]

[Means for Solving the Problem] In the exposure approach that the exposure approach by this invention carries out sequential exposure of two or more bodies (W1, W2) by the exposure beam Two or more 1st mark detection systems which are arranged in a mutually different location and detect the location of the mark on the body, respectively (13a, 13b), The 1st process which prepares the 2nd mark detection system (5a) arranged in a different location from two or more of the 1st mark detection systems, and searches for the location detection error of two or more of the 1st mark detection systems using the 2nd mark detection system, The 2nd process amended with the location detection error which detected the location of the mark on two or more of those bodies (33x, 33y) using two or more of those 1st mark detection systems, and searched for this detection result at that 1st process, It has the 3rd process which carries out sequential exposure of two or more of those bodies, performing alignment of two or more of those bodies one by one based on the positional information acquired at this 2nd process.

[0010] According to this this invention, that 2nd mark detection system can detect the mark for the location detection on the body in which location detection was carried out by two or more of those 1st mark detection systems, for example, and the location detection errors (offset etc.) of two or more of those 1st mark detection systems can be detected by processing this detection result. For this reason, carry two or more that 1st mark detection system, and these are employed efficiently. When performing alignment to exposure actuation and juxtaposition, before exposure initiation for example, after skipping the process (preparation process) which measures each location detection error of two or more of the 1st mark detection systems and shortening the setup time by test exposure Since the bad influence of the location detection error resulting from those 1st mark detection system itself is removable, it can expose for high productivity with high precision.

[0011] In this case, you may make it search for the location detection error of two or more of those 1st mark detection systems in that 1st process using the body (for example, substrate of the head of one lot) of a predetermined number from the head of two or more of those bodies. Processing is further accelerable with this. Next, the aligner by this invention is set by the exposure beam to the aligner which carries out sequential exposure of two or more bodies (W1, W2). Two or more movable stages which position the body, respectively (15a, 15b), Two or more 1st mark detection systems which are arranged corresponding to two or more of the movable stages, and detect the location of the mark on the body, respectively (13a, 13b), The 2nd mark detection system arranged in a different location from two or more of the 1st mark detection systems (5a), Based on the detection result of that 2nd mark detection system, the location detection error of two or more of those 1st mark detection systems is searched for, and it has the operation system (51) which amends the detection result of two or more of those 1st mark

detection systems with this location detection error. The exposure approach of this invention can be enforced with this aligner.

[0012] in this case, it is desirable for two or more of those movable stages to be alike, respectively, to correspond, and to prepare two or more loader sections (22a, 22b) which detach and attach that body to that movable stage. By this, the body on two or more of the movable stages can be exchanged mutually-independent, and the processing time can be shortened further. Moreover, as for two or more of the 1st mark detection systems, wavelength detects a **-ed mark, using light 500nm or more as an example. By this, when the body for exposure is the substrate with which sensitive material was applied, alignment can be performed, without exposing the sensitive material.

[0013] Moreover, the common projection optics (PL) which carries out sequential exposure of the body on two or more of the movable stages using the exposure beam which passed the mask (R) is established, and, as for the 2nd mark detection system, it is desirable to use a part of the projection optics [at least]. Furthermore, as for the 2nd mark detection system, it is desirable to detect the mark on the mask (31a) and the mark on the body to coincidence through the projection optics. Thus, the location detection error of two or more of the 1st mark detection systems can be searched for with high precision by making the 2nd mark detection system into a TTL (Through The Lens) method or a TTR (Through The Reticle) method.

[0014] Moreover, as for the 2nd mark detection system, it is desirable to detect a **-ed mark using the light of the same wavelength substantially with the exposure beam. By this, generating of the error by the chromatic aberration of projection optics PL can be prevented. However, when it has the common projection optics (PL) which carries out sequential exposure of the body on two or more of the movable stages as another method using the exposure beam which passed the mask (R), it is good also as a detection system (13c) which is arranged near the projection optics in the 2nd mark detection system, and detects a **-ed mark through the projection optics.

[0015] Next, the device manufacture approach of this invention has the process which imprints a device pattern on a work piece using the exposure approach of this invention. By this invention, various devices can be mass-produced for high productivity with high precision.

[0016]

[Embodiment of the Invention] Hereafter, with reference to a drawing, it explains per example of the gestalt of operation of this invention. This example applies this invention, when exposing using the projection aligner of step - equipped with the wafer stage system of a double stage method, and - scanning method (scan exposure method).

[0017] Drawing 1 is the outline block diagram showing the projection aligner of this example, and ArF excimer laser with a wavelength [of a vacuum ultraviolet area] of 193nm is used as the exposure light source 1 in this drawing 1 . It is F2 [with a wavelength of 157nm] as the exposure light source in addition to it. Kr2 with a laser (fluorine laser) and a wavelength of 146nm Bright-line lamps, such as laser light sources, such as laser (krypton dimer laser), KrF excimer laser with a wavelength of 248nm, a higher-harmonic generator of an YAG laser, or a higher-harmonic generator of semiconductor laser, or a mercury lamp, etc. can be used.

[0018] The exposure light IL as an exposure beam injected from the exposure light source 1 illuminates the pattern side (inferior surface of tongue) of the reticle R as a mask through the plastic surgery optical system 2 and the illumination-light study system 3. The illumination-light study system 3 is equipped with an optical integrator, the aperture diaphragm (sigma diaphragm) of an illumination system, the relay lens system, the field diaphragm, the condensing lens system, etc. Through projection optics PL, the exposure light IL which penetrated Reticle R is 1 / about 4 to 1/5-time contraction scale factor, and forms the image of the pattern of the reticle R on the wafer (wafer) W1 (or W2) as the body or the exposed substrate for exposure. Since the wafer stage system of the projection aligner of this example is a double stage method (detail after-mentioned), two wafers W1 and W2 are held free [migration] mutually-independent at the image surface side of projection optics PL. Wafers W1 and W2 are disc-like substrates, such as semi-conductors (silicon etc.) or SOI (silicon on insulator), and the photoresist (sensitive material) is applied on it.

[0019] Moreover, in order to perform alignment of wafers W1 and W2, one pair of alignment sensors 13a and 13b for wafers of an image-processing method are arranged by the off-axis method so that projection optics PL may be inserted in the direction of X. The alignment sensors 13a and 13b as 1st mark detection

system are sensors of the image formation method which consists of a FIA (Field Image Alignment) method which irradiates a **-ed mark by the illumination light of a comparatively large wavelength region with a wavelength [from a halogen lamp etc.] of 500nm or more, forms the image on an index plate, carries out the image processing of the image pick-up signal of the image, and detects the location of the **-ed mark on the basis of an index mark.

[0020] In addition, when it is the mark by which the film (for example, polish recon film) which flattening of it is carried out in a CMP (Chemical & Mechanical Polishing) process after a **-ed mark passes through a STI (Shallow Trench Isolation) process, and does not penetrate the light after that is formed, it is desirable to use the wavelength of an infrared region as a mark detection light. For example, in the alignment system of a FIA method, it is desirable to arrange a wavelength selection filter on the optical path between a halogen lamp and a **-ed mark, and to constitute so that infrared light may be irradiated to a mark. In addition, when detecting the mark by which the non-light transparency film is formed on it through STI and a CMP process, using infrared light is not restricted to the alignment system of the FIA method mentioned above, but other mark detection systems are the same.

[0021] As projection optics PL, it is for example, international public presentation (WO) besides refractive media. 00/39623 As indicated by the number As indicated by the reflective refractive media of the straight cylinder mold constituted by arranging two or more dioptric lenses and two concave mirrors which have opening near the optical axis, respectively, or the application for patent 2000-59268 in accordance with one optical axis The reflective refractive media which have optical system with the optical axis which faces to a wafer from a reticle, and reflective refractive media with the optical axis which intersects perpendicularly mostly to the optical axis can be used. The Z-axis is taken in parallel with the optical axis AX of projection optics PL hereafter, in a flat surface perpendicular to the Z-axis, in parallel with the space of drawing 1 , at right angles to the space of drawing 1 , a Y-axis is taken and the X-axis is explained. The reticle R at the time of exposure and the scanning direction of wafers W1 and W2 are the directions of Y.

[0022] First, Reticle R is held on the reticle stage 7 laid possible [a scan in the direction of Y] on the reticle base 8. The reticle base 8 is supported by the non-illustrated column. The two-dimensional location of a reticle stage 7 The migration mirror 10 (biaxial [the amount of / for the object for the X-axes and Y-axes] is in fact.) on a reticle stage 7 And it is measured by the laser interferometer 9 arranged corresponding to this. The main control system 51 to which this measurement value carries out control control of the actuation of the whole equipment is supplied, and a non-illustrated reticle stage control system controls the location and rate of a reticle stage 7 based on the control information from that measurement value and the main control system 51. The reticle stage system consists of the reticle base 8, a reticle stage 7, this drive (un-illustrating), etc. The reticle stage system is contained in the reticle stage room 11 as a sealed cabin.

[0023] on the other hand, wafers W1 and W2 are held through a non-illustrated wafer holder on wafer stage 15a as a movable stage (or substrate stage), and 15b, respectively — having — the wafer stages 15a and 15b — a wafer base 18 top — mutually-independent — the direction of Y — a scan — possible — and the direction of X and the direction of Y — a step — it is laid movable. The wafer base 18 is installed above the floor level through the vibrationproofing bases 19a and 19b (three sets or four sets are arranged in fact). It is generating the vibration for the vibrationproofing bases' 19a and 19b being constituted combining the Ayr damper and electromagnetic actuators (voice coil motor etc.) as an example, intercepting vibration of high frequency with the Ayr damper, and offsetting vibration of low frequency from an actuator, and what vibration produced by a scan or step migration of the wafer stages 15a and 15b transmits to projection optics PL and a reticle stage system is prevented.

[0024] The wafer stages 15a and 15b are driven in the direction of X, and the direction of Y with non-illustrated drives (linear motor etc.), and Z leveling device which controls the surrounding tilt angle of the X-axis and a Y-axis in the location (focal location) of the Z direction of wafers W1 and W2 and a list, respectively is included in the wafer stages 15a and 15b. Here, with reference to drawing 2 , it explains per location instrumentation system of the wafer stages 15a and 15b.

[0025] Drawing 2 is the top view showing the wafer stages 15a and 15b of drawing 1 , in this drawing 2 , migration mirror 17ax and 17ay(s) are fixed to the side face of the direction of -X of 1st wafer stage 15a, and the side face of the direction of +Y, respectively, and migration mirror 17bx and 17b(ies) are being fixed to the side face of the direction of +X of 2nd wafer stage 15b, and the side face of the direction of

+Y, respectively. Moreover, the reference mark members 14a and 14b same on the real target with which two or more reference marks were formed, respectively are being fixed to the upper right portion of wafer stage 15a, and the upper left section of wafer stage 15b so that it may become the height as the front face of wafers W1 and W2 with the same front face. Furthermore, laser interferometer 16ax of the X-axis and 16bx(es) are arranged so that it may face across the wafer base 18 in the direction of X, laser interferometer 16c of a Y-axis is arranged in the center of the side face of the direction of +Y of the wafer base 18, and laser interferometer 16ay of a Y-axis and 16b(ies) are arranged so that this laser interferometer 16c may be inserted in the direction of X.
[0026] In this example, the detection core of the alignment sensors 13a and 13b and the exposure core (this example optical axis AX) of projection optics PL are located on a straight line parallel to the X-axis, and laser interferometer 16ax of the X-axis and the optical axis of 16bx have passed the detection core of the alignment sensors 13a and 13b, and the optical axis AX of projection optics PL in the direction of X. Moreover, the optical axis of laser interferometer 16c of a Y-axis and laser interferometer 16ay, and 16by has passed through the optical axis of projection optics PL, and the detection core of the alignment sensors 13a and 13b in the direction of Y, respectively. And in case the wafer W1 on 1st wafer stage 15a is exposed, wafer stage 15a moves to the direct bottom of projection optics PL. In case the location of wafer stage 15a is measured by laser interferometer 16ax and 16c and exposes the wafer W2 on 2nd wafer stage 15b, wafer stage 15b moves to the direct bottom of projection optics PL. The location of wafer stage 15b is measured by laser interferometer 16bx and 16c.
[0027] On the other hand, in performing alignment of the wafer W1 on 1st wafer stage 15a Wafer stage 15a moves to the directly under (visual field) side of alignment sensor 13a. In the location of wafer stage 15a being measured by laser interferometer 16ax and 16ay and performing alignment of the wafer W2 on 2nd wafer stage 15b Wafer stage 15b moves to the direct bottom of alignment sensor 13b, and the location of wafer stage 15b is measured by laser interferometer 16bx and 16by. It is in the condition which an Abbe error (primary error over an angle of inclination) does not produce to the exposure core of projection optics PL by this at the time of exposure, and the location of the wafer stages 15a and 15b can be measured with high precision, respectively in the condition that an Abbe error does not arise to the detection core of the alignment sensors 13a and 13b at the time of alignment. The measurement value of those laser interferometer 16ax(es), 16bx and 16c, 16ay, and 16by is supplied to the main control system 51 of drawing 1 .
[0028] Based on the measurement value of return and the above-mentioned laser interferometer, and the control information from the main control system 51, a wafer stage control system (un-illustrating) controls the location and rate of the direction of X of the wafer stages 15a and 15b, and the direction of Y to drawing 1 . Moreover, based on the information on the focal location (location of a Z direction) in two or more measure points of the front face of the wafers W1 and W2 from a non-illustrated automatic focus sensor (sensor optical by the oblique incidence method), the wafer stages 15a and 15b control the focal location and tilt angle of wafers W1 and W2 by the servo system, respectively so that the front face of wafers W1 and W2 focuses during exposure in the image surface of projection optics PL.
[0029] The wafer stage system 12 of a double stage method consists of wafer stages 15a and 15b of the 18 or 2 wafer bases, this drive (un-illustrating), etc., and the wafer stage system 12 is contained in the wafer stage room 20 as a sealed cabin. for example, at the time of exposure of the wafer W1 on wafer stage 15a Where the pattern image of Reticle R is projected on a wafer W1 through projection optics PL The actuation which scans Reticle R and a wafer W1 by making a projection scale factor into a velocity ratio through a reticle stage 7 and wafer stage 15a synchronizing with the direction of Y, The actuation which carries out step migration of the wafer W1 is repeated by step - and - scanning method, and the pattern image of Reticle R is imprinted by each shot field on a wafer W1. Exposure to the wafer W1 on wafer stage 15b of another side is similarly performed by step - and - scanning method.
[0030] By this example, by wafer stage 15b of another side, since wafer exchange, alignment of a wafer, etc. can be performed in parallel to the time of the exposure to the wafer W1 on one wafer stage 15a, the throughput of an exposure process can be raised. Now, in case exposure to the wafers W1 and W2 on wafer stage 15a and 15b is performed in this way, it is necessary to perform alignment of wafers W1 and W2 beforehand. In that case, detection of the mark for the alignment on a wafer W1 and W2, i.e., an alignment mark, (henceforth a "wafer mark") is performed by the above-mentioned alignment sensors 13a and 13b. The detecting signal (image pick-up signal) of the alignment sensors 13a and 13b is supplied to

the alignment signal-processing system 52.

[0031] Drawing 3 is the top view showing 1st wafer stage 15a, and is set to this drawing 3 . The front face of the wafer W1 on wafer stage 15a is divided in the direction of X, and the direction of Y to two or more shot fields 32 in a predetermined pitch. 1-dimensional wafer mark 33x of the X-axis which consists of Rhine - and - tooth-space pattern which met in the direction of X so that it might correspond to the street line field 36 between the shot fields 32 to each shot field 32, And 1-dimensional wafer mark 33y of the Y-axis turning around wafer mark 33x [90-degree] of a configuration is attached. Although the wafer marks 33x and 33y are formed as a concavo-convex mark or a mark with predetermined reflection factor distribution, they may use a two-dimensional mark like a box Inn box mark other than a 1-dimensional mark, and may form the wafer mark in the interior of the shot field 32.

[0032] Moreover, on reference mark member 14a on wafer stage 15a, the reference marks 34a and 34b of the two-dimensional frame type for reticles are formed so that two-dimensional reference mark 35a for alignment sensor 13a (Rhine [of the direction of X and the direction of Y] - and - tooth-space pattern should put together as an example) may be inserted in the direction of X. The physical relationship of reference marks 34a and 34b and reference mark 35a is measured with high precision beforehand, and is memorized by the storage section in the main control system 51. Similarly, on reference mark member 14b on 2nd [of drawing 2] wafer stage 15b, two reference marks for reticles (un-illustrating) are formed so that central reference mark 35b may be inserted in the direction of X.

[0033] With this configuration, if wafer mark 33x on a wafer W1 are observed using alignment sensor 13a, as shown in the index plate in it at drawing 4 (A), image 33xP of wafer mark 33x will be formed so that it may be inserted into index mark 37x, and these images will be relayed on a two-dimensional image sensor. In the alignment signal-processing system 52 of drawing 1 , the detecting signal from alignment sensor 15a is processed, the amount of location gaps to the direction of X of wafer mark 33x to the core (detection core) of index mark 37x is detected, and this detection result is supplied to the main control system 51. Similarly, the amount of location gaps of wafer mark 33y of the Y-axis to a detection core is also supplied to the main control system 51.

[0034] By the main control system 51, the array coordinate of the wafer marks 33x and 33y on the basis of the detection core of alignment sensor 13a, as a result the array coordinate of the shot field 32 are searched for by adding the amount of location gaps of the wafer marks 33x and 33y detected by alignment sensor 13a to the coordinate of wafer stage 15a measured by laser interferometer 16ax and 16ay. In fact, alignment is performed by the ENHANSUTO global alignment (EGA) method which measures the coordinate of the wafer mark of the shot field of the number of appointed numbers chosen from on a wafer, carries out statistics processing of this measurement result, and searches for the array coordinate of all shot fields as indicated by JP,4-47968,B. About alignment sensor 13b of another side, the location of the wafer mark on a wafer W2 is detectable similarly.

[0035] In drawing 1 moreover, above the reticle R in the reticle stage room 11 The mark for alignment on Reticle R, i.e., the alignment mark of a reticle, (it is hereafter called a "reticle mark".) In order to detect the location of 31a and 31b, the mirrors 6a and 6b for optical-path bending are minded, and it is a reticle alignment microscope (it is hereafter called "RA microscope".) as 2nd mark detection system. 5a and 5b are arranged. The physical relationship of the reticle marks 31a and 31b and the original edition pattern of Reticle R is measured with high precision beforehand, and is memorized by the storage section in the main control system 51. The RA microscopes 5a and 5b are the illumination light ILa and ILb of the respectively same wavelength as the exposure light IL, it is the sensor of the image-processing method (image formation method) which detects a **-ed mark by the TTR (Through The Reticle) method, and a part of exposure light which branched in the exposure light source 1 is supplied to the RA microscopes 5a and 5b through the light transmission optical system 4a and 4b, respectively.

[0036] At the time of the alignment of Reticle R, positioning of wafer stage 15a is performed so that the reference marks 34a and 34b of drawing 3 may come to the location almost same as an example as the image by the projection optics PL of the reticle marks 31a and 31b of drawing 1 , respectively. In this condition, one RA microscope 5a illuminates reference mark 34a on wafer stage 15a through Reticle R and projection optics PL while illuminating one reticle mark 31a by the illumination light of the same wavelength as the exposure light IL. Since the illumination light is exposure wavelength, reticle mark 31a and reference mark 34a are mutually arranged on the field [****] about projection optics PL, and a very high measurement precision is acquired. The illumination light reflected by that reference mark 34a and

the illumination light reflected by reticle mark 31a form the image of reference mark 34a, and the image of reticle mark 31a in piles on a two-dimensional image sensor through the image formation optical system in RA microscope 5a, and the image pick-up signal of this image is supplied to the alignment signal-processing system 52.

[0037] Drawing 4 (B) shows the visual field of RA microscope 5a, and image 34aR of reference mark 34a of the shape of a small frame is formed in frame-like reticle mark 31a in this drawing 4 (B). The alignment signal-processing system 52 of drawing 1 processes the image pick-up signal, and calculates the amount of location gaps of the direction of X of reference mark 34a to the core of the image of reticle mark 31a, and the direction of Y. By processing the image pick-up signal of RA microscope 5b of another side by the alignment signal-processing system 52 similarly, the amount of location gaps of reference mark 34b to the core of the image of reticle mark 31b of another side is calculated, and these amounts of location gaps are supplied to the main control system 51. It asks for the tilt angle of the straight line which connects with the main control system 51 the core of the mark of the latter to the straight line which connects the core of the amount of location gaps from the amount of location gaps of two reference marks 34a and 34b to the direction of X of the core of the reference marks 34a and 34b to the core of the image of the reticle marks 31a and 31b and the direction of Y, and the former mark image. And the main control system 51 is adjusting the location and angle of rotation of Reticle R through a reticle stage 7 as an example, and alignment of Reticle R is performed so that the calculated amount of location gaps and a tilt angle may be settled in predetermined tolerance. Similarly, alignment of Reticle R can be performed also by using reference mark member 14b on wafer stage 15b of another side.

[0038] Furthermore, in this example, the RA microscopes 5a and 5b can be used, also when searching for the location detection error of two alignment sensors 13a and 13b like the after-mentioned as 2nd mark detection system. Furthermore, as shown in drawing 2 , 3rd alignment sensor 13c of an image formation method is arranged by the off-axis method as well as the alignment sensors 13a and 13b, and the image pick-up signal of alignment sensor 13c is also supplied to the location which approaches in the direction of +Y to the projection optics PL of the upper part of the wafer stage system 12 at the alignment signal-processing system 52 of drawing 1 . Even if this 3rd alignment sensor 13c supports the 2nd mark detection system like the RA microscopes 5a and 5b and uses this alignment sensor 13c, it can search for the location detection error of two alignment sensors 13a and 13b like the after-mentioned.

[0039] Since the exposure light IL of this example is vacuum-ultraviolet light substantially, furthermore, from the optical path of the exposure light IL from the exposure light source 1 to wafers W1 and W2 The gas which eliminates the powerful absorptivity gas (oxygen, a steam, a carbon dioxide, organic gas, etc.) of the absorption to vacuum-ultraviolet light, and penetrates the exposure light IL instead, i.e., a gas with the high transmission to the exposure light IL, (it is hereafter called "purge gas".) It is necessary to permute the optical path. As the purge gas, nitrogen, rare gas (helium, neon, an argon, a krypton, a xenon, radon), or these mixture of gas can be used, for example. In rare gas, since its amount of fluctuation of the refractive index to change of an atmospheric pressure is small, when helium excels [thermal conductivity] in temperature stability highly, and thinking the stability of an image formation property etc. as important, as purge gas, its helium is desirable. However, for an application which wants to hold down operation cost low, nitrogen may be used as purge gas.

[0040] So, in this example, the gas inside each sealed cabin which consists of the subchamber (un-illustrating) and the reticle stage room 11 where the plastic surgery optical system 2 and the illumination-light study system 3 are contained, projection optics PL, and a wafer stage room 20 is permuted by the purge gas. As an example, the permutation by the purge gas can connect an exhaust pipe and a feed pipe to some septa of each sealed cabin, and the method which supplies the purge gas, decompresses once the flow controls into which made it make an internal gas flow from an exhaust pipe, or those interior, and is re-filled up with purge gas from a feed pipe can perform it.

[0041] In addition, absorption according to absorptivity gas when the exposure light IL is ArF excimer laser (wavelength of 193nm) like this example is F2. If compared with laser (wavelength of 157nm) etc., since it is few, there will not necessarily be no need of supplying the purge gas of a high grade to all of the optical paths of the exposure light IL from the point of the illuminance of the exposure light on a wafer. However, when the wafer stage system 12 is a double stage method like this example, the optical path length of laser interferometer 16ax, 16bx, 16ay, 16by, and 16c increases and the consistency fluctuation of the ambient atmosphere gas on the optical path of a measurement beam becomes large in

this condition, there is a possibility that the location measurement error of the wafer stages 15a and 15b may also increase. Therefore , also in the case of comparatively little wavelength (ArF excimer laser like [For example ,] the example of KrF excimer laser or a book) of absorption by absorptivity gas , the wafer stage room 20 be form , and in permute the inside of it with the purge gas which consist of small helium of refractive index change to consistency change , exposure wavelength can make small the measurement error of laser interferometer 16ax and 16bx - 16c , and can aim at improvement in the location precision of an imprint pattern .

[0042] Moreover, in this example, as shown in drawing 2 , the wafer stage room 20 is adjoined, a spare room 29 is arranged, and the wafer loader system 30 for performing carrying in and taking out of a wafer to the wafer stage system 12 in a spare room 29 is arranged. Namely, so that opening prepared near the alignment sensors 13a and 13b of the wafer stage room 20 may be covered The load locks chamber 21a and 21b which consist of a sealed cabin are installed in a spare room 29. Between load locks chamber 21a and 21b and the wafer stage room 20, the shutters 27a and 27b which can be opened and closed freely are arranged, and the shutters 28a and 28b for opening and closing opening between other space in load locks chamber 21a and 21b and a spare room 29 are also arranged. In case Shutters 27a and 27b are opened, Shutters 28a and 28b are closed and it fills up with the same purge gas as the gas supplied in the wafer stage room 20 into load-lock-chamber 21a and 21b. In addition, exposure wavelength is comparatively long, and when purge gas does not need to permute the space near the wafers W1 and W2, it cannot be overemphasized that it is not necessary to supply purge gas also into load-lock-chamber 21a and 21b.

[0043] Moreover, the load arms 22a and 22b for delivering a wafer among the wafer stages 15a and 15b in load-lock-chamber 21a and 21b, respectively are arranged, and conveyance Rhine 23 and the wafer cassette 26 which contains a wafer are installed before load locks chamber 21a and 21b. The wafer cassette 26 is installed in the bottom of atmospheric environment. Moreover, along conveyance Rhine 23, the conveyance arm 25 which delivers a wafer between the wafer cassettes 26 is arranged, and the conveyance arms 24a and 24b for delivering a wafer among load locks chamber 21a and 21b are also arranged on conveyance Rhine 23 free [migration in the direction of X]. The wafer loader system 30 consists of these load arms 22a and 22b, conveyance Rhine 23, conveyance arms 24a, 24b, and 25, and wafer cassette 26 grade.

[0044] Next, with reference to the flow chart of drawing 5 , it explains about an example of the exposure sequence in the case of exposing to the wafer of one lot with the projection aligner of this example. First, it is carrying-in **** to load-lock-chamber as [shown in drawing 2], and after wafer (it considers as wafer W1) of head in the 1 lot (1st sheet) was picked out from wafer cassette 26 by conveyance arm 25 and conveyance arm 24a was passed in step 101 of drawing 5 21a. Here, after the gas of the wafer circumference is permuted by purge gas, a wafer W1 is loaded by load arm 22a on 1st wafer stage 15a. Next, the 2nd wafer (it considers as a wafer W2) is loaded by load arm 22b on 2nd wafer stage 15b, after it is carried in to load-lock-chamber 21b through the conveyance arm 25 and conveyance arm 24b and the gas of the circumference of it is permuted by purge gas from the wafer cassette 26.

[0045] In the following step 102, the wafer marks 33x and 33y which drove 1st wafer stage 15a and were attached to the predetermined shot field on a wafer W1 are moved into the visual field of alignment sensor 13a one by one, and the location of those wafer marks is measured. In parallel to this actuation, the location of the predetermined wafer mark of the wafer W2 on 2nd wafer stage 15b is measured using alignment sensor 13b. Using these measurement values, by the main control system 51 of drawing 1 , the array coordinate (coordinate on the basis of the detection core of alignment sensor 13a) of all the shot fields on a wafer W1 and the array coordinate (coordinate on the basis of the detection core of alignment sensor 13b) of all the shot fields on a wafer W2 are computed, and the acquired array coordinate is memorized in the storage section in the main control system 51.

[0046] Next, in step 103, a part of measurement of the amount of base lines of the alignment sensors 13a and 13b (an exposure core and spacing based on detection) is performed. Namely, the reference marks 35a and 35b of the center of the reference mark members 14a and 14b prepared on wafer stage 15a and 15b are moved into the visual field of the alignment sensors 13a and 13b, respectively. The alignment sensors 13a and 13b detect the amount of location gaps based on [over reference marks 35a and 35b] detection (deltaX1a, deltaY1a), respectively (physical relationship (deltaX1b, deltaY1b)). It means that the physical relationship of the reference mark members 14a and 14b, and a wafer W1 and each shot field on

W2 (circuit pattern) had been measured by this.
[0047] Next, in step 104, after driving the reticle stage 7 of drawing 1 and moving the reticle marks 31a and 31b of Reticle R near the core of the visual field of the RA microscopes 5a and 5b, respectively, 1st wafer stage 15a is driven and reference mark member 14a is moved directly under projection optics PL. In the middle of this migration, the interferometer which measures the Y coordinate of wafer stage 15a changes from laser interferometer 16ay to laser interferometer 16c. When there is the condition (condition which does not have migration mirror 17ay on the optical path from both interferometers) that neither both laser interferometer 16ay(s) nor 16c can measure the location of wafer stage 15a, however, at the time In order that the Y coordinate of wafer stage 15a may not be clear anymore, it is desirable to prepare the linear encoder for performing location measurement roughly etc., or to make X lay length of migration mirror 17ay into the die length more than spacing of laser interferometer 16ay and laser interferometer 16c.
[0048] And since the reference marks 34a and 34b (refer to drawing 3) on reference mark member 14a are moved near the location of the image by the projection optics PL of the above-mentioned reticle marks 31a and 31b, the amount of location gaps of the direction of X of the reference marks 34a and 34b to the projection image of the reticle marks 31a and 31b and the direction of Y (physical relationship) is measured using the RA microscopes 5a and 5b of drawing 1 . In addition, although some position errors have arisen on the occasion of above laser interferometer 16ay and the change of 16c, since the physical relationship of the projection image (projection image of a reticle mark) of the pattern of Reticle R and wafer stage 15a (reference mark member 14a) is newly measured by location detection of the reference marks 34a and 34b in the RA microscopes 5a and 5b, the above-mentioned position error does not become a problem at all by it.
[0049] Moreover, the physical relationship of the reference marks 34a and 34b on reference mark member 14a and reference mark 35a is known, and can calculate the amount of location gaps of the direction of X of the core of the reference mark 35 to the core of the projection image of the reticle marks 31a and 31b, and the direction of Y (deltaX2a, deltaY2a) from the above-mentioned measurement value. Furthermore, since the location of the latter reference mark 35a is already measured by alignment sensor 13a, the physical relationship of the projection image of the pattern of Reticle R and each shot field on a wafer W1 (circuit pattern) is determined by this. In this example, the amount of location gaps which adds the amount of location gaps based on [over reference mark 35a measured by alignment sensor 13a at step 103] detection (deltaX1a, deltaY1a) to the amount of location gaps of reference mark 35a to the core of the projection image of the reticle marks 31a and 31b (deltaX2a, deltaY2a), and is obtained turns into the amount of base lines of alignment sensor 13a (BLXa, BLYa). That is, it is as follows.
[0050]
BLXa=deltaX1a+deltaX2a — (1A)
BLYa=deltaY1a+deltaY2a — (1B)
It is changing the array coordinate of each shot field on the wafer W1 on the basis of the detection core of the above-mentioned alignment sensor 13a into the array coordinate on the basis of the core of the projection image of the reticle marks 31a and 31b, as a result the core (exposure core) of the pattern image of Reticle R as an example using the amount of base lines, and the alignment of a wafer W1 is completed.
[0051] And in step 105, scan exposure of the image of the pattern of Reticle R is carried out to each shot field on a wafer W1, driving wafer stage 15a based on the array coordinate after the conversion. In this case, since alignment is performed as mentioned above, to the circuit pattern already formed in each shot field on a wafer W1, the image of the pattern of Reticle R is laid on top of accuracy, respectively, and is imprinted.
[0052] Next, in step 106, 1st wafer stage 15a of drawing 2 is made to shunt in the direction of -X, laser interferometer 16by of a Y-axis and the change between 16c are performed, and 2nd wafer stage 15b is moved directly under projection optics PL. And like step 104,105, under the RA microscopes 5a and 5b, the amount of location gaps of the predetermined reference mark of reference mark member 14b on wafer stage 15b is measured, and the amount of base lines of alignment sensor 13b (BLXb, BLYb) is calculated based on this measurement result. And based on this amount of base lines, the array coordinate of each shot field on a wafer W2 is changed into the array coordinate on the basis of an exposure core (completion of alignment), wafer stage 15b is driven based on the array coordinate after this conversion,

and the pattern image of Reticle R is piled up and imprinted to each shot field of a wafer W2.
[0053] Thus, when exposing by wafer stage 15b, in 1st wafer stage 15a, the wafer loader system 30 is used, wafers are exchanged, and the predetermined wafer mark of the wafer after exchange is measured by alignment sensor 13a. And wafer stage 15b [finishing / exposure] is made to shunt in the direction of +X at the following step 107, wafer stage 15a is moved directly under projection optics PL, and base-line measurement, conversion of the array coordinate of each shot field on a wafer, and exposure to a wafer are performed. In the meantime, in wafer stage 15b, wafer exchange and location measurement by alignment sensor 13b are performed, and it exposes by turns to the wafer on wafer stage 15a and 15b below. A high throughput is obtained by this.
[0054] By the way, when the location detection error remains in alignment sensor 13a for wafers, and the 13b itself in this example, it originates in the detection error, a minute alignment error (superposition error) arises, and there is a possibility that yields, such as a semiconductor device finally manufactured, may get worse. That is, if the location detection error accompanying the slight aberration and the bad alignment in the optical system of the alignment sensors 13a and 13b is changed according to change of the depth of the wafer mark on a wafer, or a reflection factor, or change of the line breadth ratio of the heights of a wafer mark, and a crevice etc., whenever a wafer process will change and a wafer mark will change, the location detection error will also be changed delicately and an alignment error will produce it.
[0055] In the projection aligner which was made to correspond to two wafer stages 15a and 15b of the wafer stage system 12 like especially this example, and is equipped with two alignment sensors 13a and 13b In order to search for the location detection error, as a result a relative error, supposing it performs test exposure from a head to two wafers, the development and measurement time amount of a wafer for evaluation become long, and there is a possibility of seldom raising the throughput as the whole.
[0056] So, in this example, it is made to amend the location detection error of the alignment sensors 13a and 13b as 1st mark detection system for a short time using the 2nd mark detection system as follows. The above-mentioned RA microscopes 5a and 5b are first used as 2nd mark detection system as the 1st example. The RA microscopes 5a and 5b Since the relative-position relation between the predetermined reference mark of the reference mark members 14a and 14b on wafer stage 15a and 15b and the reticle marks 31a and 31b on Reticle R is measurable as mentioned above, If a wafer W1 and the predetermined wafer marks 33x and 33y on W2 are used instead of the reference mark, it will become measurable [the physical relationship of the reticle marks 31a and 31b on Reticle R, and a wafer W1 and the circuit pattern of each shot field on W2].
[0057] It specifically sets to step 111 in the measurement sequence of the location measurement error of drawing 6 . After detecting the location of reference mark 35a of reference mark member 14a on 1st wafer stage 15a using 1st alignment sensor 13a of drawing 2 , The location of the wafer marks 33x and 33y attached to a certain specific shot field on a wafer W1 is detected by alignment sensor 13a, and it asks for the location xi of the wafer marks 33x and 33y (X component and Y component are included) on the basis of the reference mark 35a. It asks for the location eta of the reticle mark of the X-axis attached to the specific shot field on a wafer W2 using 2nd alignment sensor 13b on the basis of reference mark 35of reference mark member 14b on 2nd wafer stage 15b b, and a Y-axis (X component and Y component are included) in parallel to this.
[0058] Next, in step 112, the location (for example, the amount of location gaps to reticle mark 31a) of reference mark 35a on 1st wafer stage 15a is measured using one RA microscope 5a, and the coordinate of this measurement value and wafer stage 15a at this time is memorized as the 1st location by the main control system 51. Next, wafer stage 15a is driven, the wafer mark on the wafer W1 measured at step 111 is moved into the visual field of RA microscope 5a, the location (for example, the amount of location gaps to reticle mark 31a) of that wafer mark is measured by RA microscope 5a, and the coordinate of this measurement value and wafer stage 15a at this time is memorized as the 2nd location by the main control system 51. By the main control system 51, it asks for the location alpha of the wafer mark of the specification (X component and Y component are included) on the basis of reference mark 35a by deducting the 1st location from the 2nd above location.
[0059] In the following step 113, it asks for the location beta of the wafer mark of the specification (X component and Y component are included) on the basis of reference mark 35b using the RA microscope 5a by measuring the location of the specific wafer mark measured at step 111 on reference mark 35b and the wafer W2 of reference mark member 14b on 2nd wafer stage 15b similarly. Thus, the locations alpha

and beta measured express the physical relationship of the reference marks 35a and 35b measured by RA microscope 5a and the specific wafer mark on a wafer W1 and W2.
[0060] Although such physical relationship (alpha, beta) is equivalent to the physical relationship (xi, eta) currently measured by each alignment sensor 13a and 13b at step 111 about the group of both wafer stages 15a and 15b and wafers W1 and W2, the physical relationship measured by the alignment sensors 13a and 13b includes the location detection error resulting from the alignment sensors 13a and 13b. On the other hand, since the physical relationship measured by RA microscope 5a is measured under a common microscope to both wafer stages 15a and 15b, there is no relative error resulting from a microscope. Therefore, it is possible to amend the physical relationship measured by the alignment sensors 13a and 13b based on the measurement result in RA microscope 5a.
[0061] Now, the location of the specific wafer mark to reference mark 35a measured by RA microscope 5a about the wafer W1 on wafer stage 15a is alpha, and the location of the specific wafer mark to reference mark 35b measured by RA microscope 5a about the wafer W2 on wafer stage 15b is beta. In addition, these values alpha and beta are not in agreement with the location gap at the time of loading of both the wafers W1 and W2 of both wafers stage 15a and 15b HE.
[0062] The location of the specific wafer mark to reference mark 35b which the location of the specific wafer mark to reference mark 35a measured by alignment sensor 13a about the wafer W1 on wafer stage 15a is xi, and was measured by alignment sensor 13b about the wafer W2 on wafer stage 15b on the other hand is eta. At this time, if it is original, it should become alpha=xi and beta=eta, and the amount of gaps from such equality expresses the relative error between [of two] alignment sensor 13a and 13b.
[0063] Then, in step 114, the main control system 51 memorizes the difference of locations alpha and xi in quest of the difference of correction value deltaASa and locations beta and eta as correction value deltaASb as follows. Correction value delta ASa and delta ASb has X component and Y component, respectively.
delta ASa=alpha-xi — (2A)
delta ASb=beta-eta — (2B)
In addition, measurement actuation of step 111 in the above-mentioned measurement sequence can be performed in step 102,103 in the exposure sequence of drawing 5 . Moreover, measurement actuation of steps 112 and 113 can be performed at step 104 of drawing 5 , and the measurement process in 106, respectively. In this case, what is necessary is to perform step 114, respectively before the exposure initiation before exposure initiation of step 105, and in step 106, and just to amend the array coordinate of a wafer W1 and each shot field on W2 using the correction value delta ASa and delta ASb calculated by this.
[0064] then, in step 107 in the exposure sequence of drawing 5 , in case the location of the wafer mark of the wafer on wafer stage 15a and 15b is detected using the alignment sensors 13a and 13b The location which added correction value deltaASa to the location detection result of alignment sensor 13a is used for the main control system 51 as an actual location of a wafer mark, and the location which added correction value deltaASb to the location detection result of alignment sensor 13b is used for it as an actual location of a wafer mark. This can amend the location detection error resulting from alignment sensor 13a and the 13b itself.
[0065] In addition, generally a wafer W1 and the photoresist applied on W2 have the large absorption to the light of exposure wavelength. For this reason, time amount comparatively long for quantity of light addition will be needed for detection of the wafer mark by RA microscope 5a (or 5b) which uses the illumination light of exposure wavelength. However, only at the head of the lot of the wafer which there is no need of carrying out unless the configuration of a wafer mark changes, for example, is processed, re-measurement of the relative error between [of two] alignment sensor 13a and 13b is enough, if re-measurement is performed. Therefore, the time amount which the above-mentioned quantity of light addition takes is slight, and the fall of the throughput by this does not become a problem.
[0066] Moreover, since the above-mentioned correction value delta ASa and delta ASb calculated with the top wafer, respectively is only added and exposed to the location detection result of the alignment sensors 13a and 13b about the wafer after the 2nd sheet exposed on each wafer stages 15a and 15b in the wafer of the same lot in the gestalt of the above-mentioned operation, there is no increment in the processing time.
[0067] On the wafer, the wafer mark is usually formed corresponding to each of many shot fields. In

addition, as an alignment method of a wafer Detect the location of 8-about 10 of wafer marks of it, carry out statistics processing of it, and the array coordinate of each shot field on a wafer is determined. The above-mentioned en hunger strike global alignment (EGA) method exposed by positioning a wafer based on the array coordinate is common. Then, the location detection by the alignment sensors 13a and 13b and RA microscope 5a (or 5b) in steps 111-113 can also adopt the EGA method.
[0068] In this case, the result which applied the above-mentioned correction value delta ASa and delta ASb to each location detection result of the wafer mark according to measured individual, and was obtained can be processed by the EGA method, and it can also expose based on this result. It is necessary to make the storage section (for example, RAM) of the main control system 51 memorize only the number of the wafer marks which measure correction value delta ASa and delta ASb in this example.
[0069] Or there is also the approach of amending the "mean position" of the result which processed the EGA method, without amending about the detection location of the wafer mark according to individual, and was processed by the EGA method with the above-mentioned correction value delta ASa and delta ASb. What is necessary is to adopt the mean position of two or more wafer marks, and just to memorize 1 set of correction value delta ASa and delta ASb in this example, as locations alpha, beta, xi, and eta where the wafer mark to the reference marks 35a and 35b in the wafer of a lot head is measured.
[0070] Although RA microscope 5a (or 5b) which uses the illumination light of exposure wavelength was used as 2nd mark detection system in the above example, of course, it is also possible for the 2nd mark detection system not to be limited to this, and to use other location detection systems. So, in the 2nd example, 3rd alignment sensor 13c of the off-axis method formed in the migration stroke of the wafer stages 15a and 15b near the projection optics PL of drawing 2 can be used as the 2nd mark detection system. In this case, since it is not necessary to use the light of exposure wavelength as illumination light, the photoresist on a wafer W1 and W2 can be made to be able to expose, it is afraid, and there is nothing and the location detection error of the alignment sensors 13a and 13b can be measured.
[0071] Moreover, a chromatic-aberration amendment member is prepared as another example in a part of optical path (for example, between Reticle R and projection optics PL and the pupil surface of projection optics PL) of the RA microscopes 5a and 5b of drawing 1 . As the RA microscopes 5a and 5b detect a **-ed mark using the illumination light of wavelength other than exposure wavelength, the RA microscopes 5a and 5b of this non-exposing wavelength may be used as 2nd mark detection system.
[0072] Moreover, although the reticle mark on Reticle R is not referred to, the alignment sensor of the TTL (ThroughThe Lens) method which detects the location of a wafer mark or a reference mark through projection optics PL is also employable as the 2nd mark detection system. This arranges the mirror for optical-path bending between for example, the reticle R and projection optics PL, and arranges an alignment sensor out of the optical path of the exposure light IL of the point, and the both sides of exposure wavelength and non-exposing wavelength are usable as illumination light.
[0073] Furthermore, in the gestalt of the above-mentioned operation, it is possible as 1st and 2nd mark detection systems not only an image pick-up method but to adopt the detection method which performs detection on the strength using the Moire fringe of a diffraction grating, the method which scans the sheet beam of a laser beam and detects the scattered light from a **-ed mark. In addition, in the gestalt of the above operation, and its modification, absolutely, also when [of the 2nd mark detection system (for example, 3rd alignment sensor 13c)] detection precision is inferior to the precision of the 1st mark detection system for error measurement (alignment sensors 13a and 13b), it is considered. In such a case, it is desirable to adopt "the correction value over the average after processing by the EGA method" as the above-mentioned correction value delta ASa and delta ASb. Moreover, it is desirable to increase the count of the wafer mark on a wafer from the time of the usual exposure, and to heighten the equalization effectiveness of that measurement value about measurement in the above-mentioned lot head, for improvement in the measurement precision of this correction value.
[0074] Or it is also possible to amend the measurement value of the alignment sensors 13a and 13b (1st mark detection system) apart from the amendment approach of the gestalt the above-mentioned operation based on the correction value computed by the following approaches. Although both the locations alpha and beta measured with the gestalt of the above-mentioned operation are locations of the specific wafer mark on the wafer on the basis of the reference marks 35a and 35b by RA microscope 5a (2nd mark detection system), as above-mentioned, the wafer stages 15a and 15b differ, and, as for Both alpha and beta, for a certain reason, its minute location gap at the time of wafer loading does not

correspond, either. However, both difference (= alpha-beta) measured by RA microscope 5a should become the same also when it measures by two or more alignment sensors 13a and 13b (1st mark detection system) without a relative difference. Therefore, it is thought that the remainder delta given by the degree type of the difference (= xi-eta) and the difference of locations alpha and beta of the locations xi and eta measured by the alignment sensors 13a and 13b with the gestalt of the above-mentioned operation (= alpha-beta) is a relative difference of two or more alignment sensors 13a and 13b.
[0075]
(xi-eta) - (alpha-beta)=delta --- (3)
Therefore, the relative difference of the detection result of two alignment sensors 13a and 13b becomes possible [amending] by adding or subtracting the value of the one half of the remainder delta at the measurement value of each alignment sensors 13a and 13b. delta/2 will be subtracted from the detection result of alignment sensor 13a of correspond a side in a location xi, and, specifically, delta/2 will be added to the detection result of alignment sensor 13b of correspond a side in a location eta. Such amendment processing enables it to amend effectively only the relative difference of the alignment sensors 13a and 13b, carrying out the maximum respect of the detection result of the alignment sensors 13a and 13b about precision absolutely. In addition, it is the same as that of the case of the point that it is more desirable to also perform this amendment to a "mean position" after processing by the EGA method.
[0076] In addition, although both the gestalten of the above operation showed the example of the projection aligner equipped with the wafer stages 15a and 15b and two alignment sensors 13a and 13b, it is not limited to two pieces and this number can also equip three pieces or four wafer stages, and an alignment sensor. Moreover, reference marks 35a and 35b are not arranging at a time on [one] each wafer stage 15a and 15b, respectively, but arranging a large number like the gestalt of the above operation, and equalizing also about the measurement result, and much more improvement in measurement precision is possible for them. Many reference marks in that case are good to arrange in each location of the four corners of the wafer stages 15a and 15b.
[0077] When manufacturing a semiconductor device on a wafer using the projection aligner of the gestalt of the above-mentioned operation, in addition, this semiconductor device The step which performs the function and engine-performance design of a device, the step which manufactures the reticle based on this step, The step which makes a wafer from a silicon ingredient, the step which performs alignment with the projection aligner of the gestalt of the above-mentioned operation, and exposes the pattern of a reticle to a wafer, It is manufactured through a device assembly step (a dicing process, a bonding process, and a package process are included), an inspection step, etc.
[0078] Moreover, it can apply also to the aligner for, for example, manufacturing various devices, such as an aligner for display units, such as a liquid crystal display component formed in the glass plate of a square shape, or a plasma display, and image sensors (CCD etc.), a micro machine, the thin film magnetic head, a DNA chip, widely, without being limited to the aligner for semiconductor device manufacture as an application of the aligner of this invention. Furthermore, this invention is applicable also to the exposure process (aligner) at the time of manufacturing the masks (a photo mask, reticle, etc.) with which the mask pattern of various devices was formed using a photolithography process.
[0079] In addition, of course, configurations various in the range which this invention is not limited to the gestalt of above-mentioned operation, and does not deviate from the summary of this invention can be taken.
[0080]
[Effect of the Invention] The relative location detection error which exists among two or more of the mark detection systems can be amended without according to this invention, performing test exposure about each of two or more mark detection systems, when it has two or more movable stages and mark detection systems (alignment sensor) for the improvement in a throughput (throughput). Therefore, the ease equivalent to the case where the aligner which only one piece equips with the conventional mark detection system performs test exposure of treating is realizable. Furthermore, it has two or more movable stages and mark detection systems, and since those juxtaposition actuation is possible, the large improvement in a throughput is attained.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the block diagram which cut and lacked the part which shows the projection aligner of an example of the gestalt of operation of this invention.
[Drawing 2] It is the block diagram which cut and lacked the part which shows the wafer stage system 12 and the wafer loader system 30 of a projection aligner of drawing 1 .
[Drawing 3] It is the top view showing the wafer mark of the wafer W1 on wafer stage 15a of drawing 1 , and the reference mark of reference mark member 14a.
[Drawing 4] The enlarged drawing showing an example for the visual field at the time of (A) measuring the location of a wafer mark and (B) are the enlarged drawings showing an example of the visual field at the time of measuring the location of a reference mark.
[Drawing 5] It is the flow chart which shows an example of the exposure sequence of the gestalt of the operation.
[Drawing 6] It is the flow chart which shows an example of the sequence which measures the location measurement error of the alignment sensors 13a and 13b in the gestalt of the operation.
[Description of Notations]
R — A reticle, PL — Projection optics, W1, W2 — A wafer, 5a, 5 b—RA microscopes (reticle alignment microscope), 7 — A reticle stage, 12 — A wafer stage system, 13a, 13b — Alignment sensor, 14a, 14b [-- A reticle mark, 33x, 33y / — A wafer mark, 34a, 34b / — A reference mark 35a, 35b / — A reference mark 51 / — Main control system] — A reference mark member, 15a, 15b — A wafer stage, 30 — A wafer loader system, 31a, 31b

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[Translation done.]

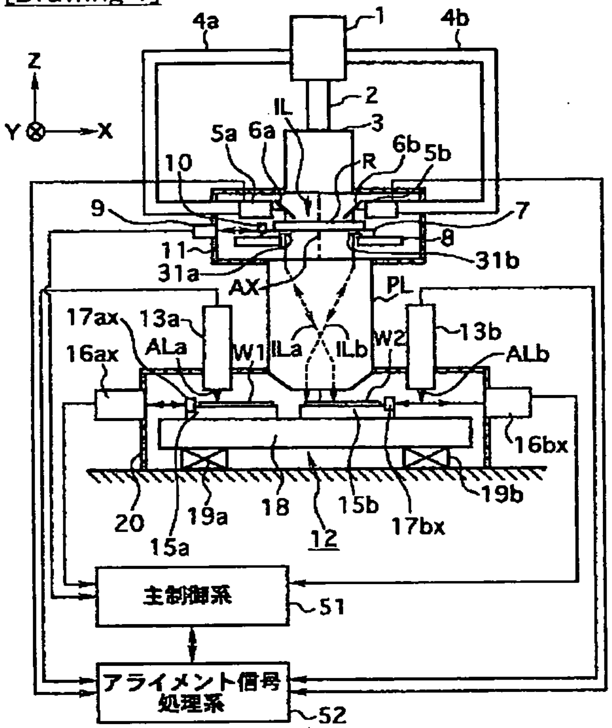
* NOTICES *

JPO and INPIT are not responsible for any damages caused by the use of this translation.

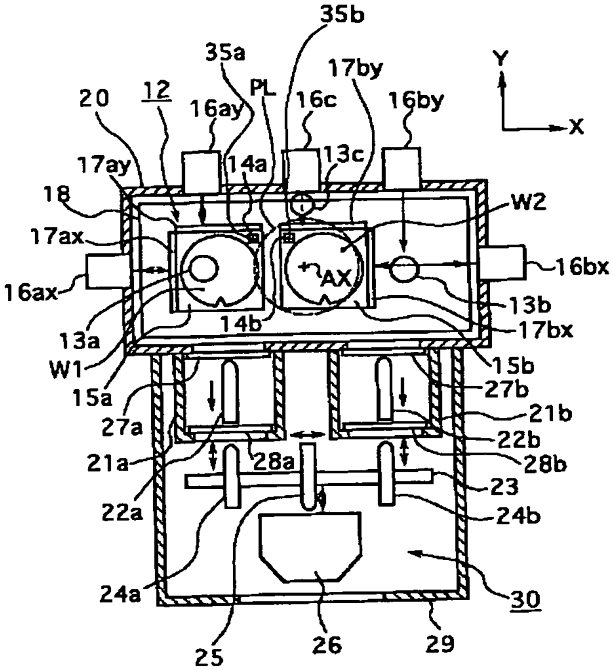
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

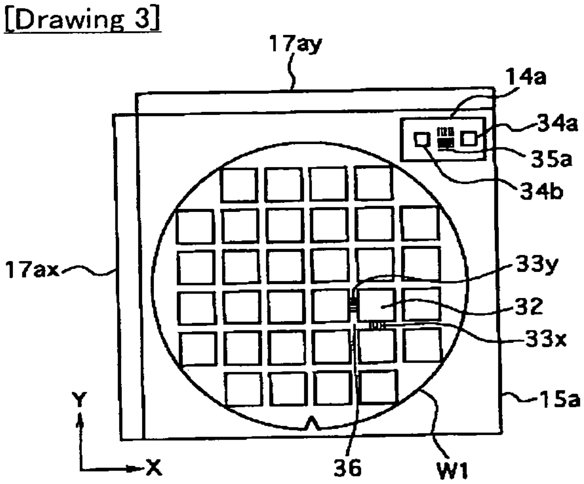
[Drawing 1]



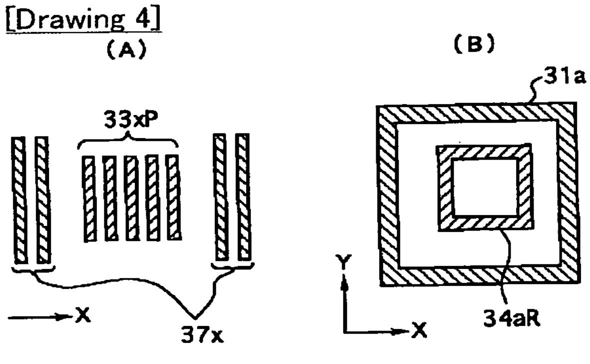
[Drawing 2]



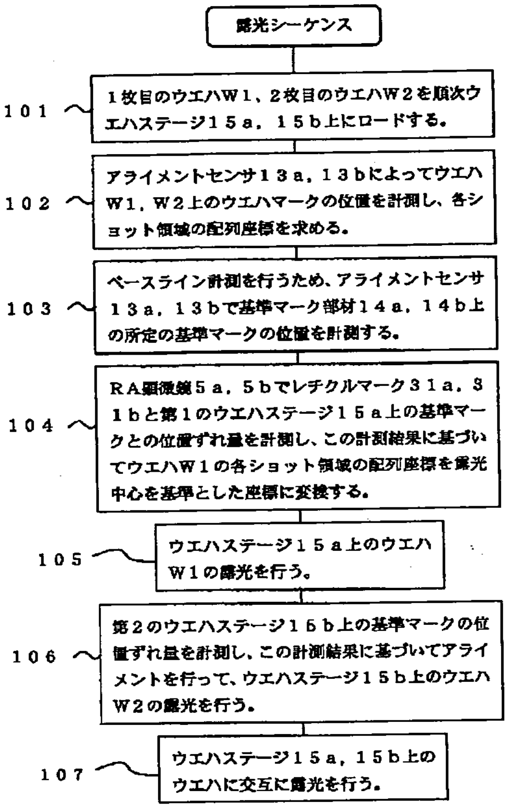
[Drawing 3]



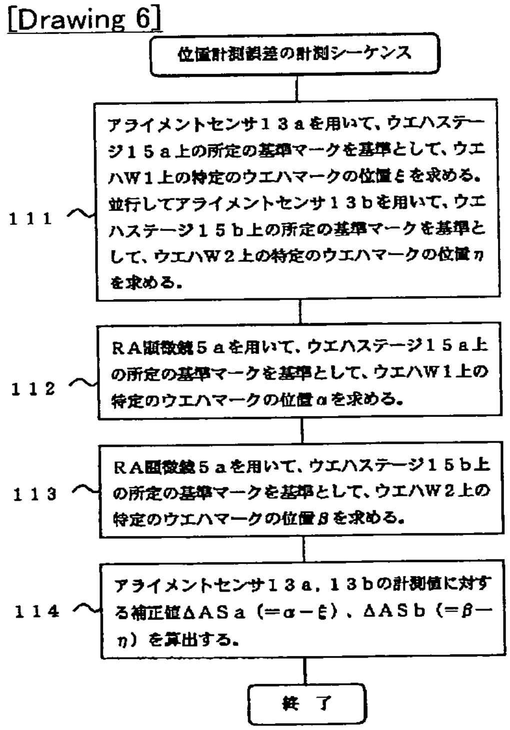
[Drawing 4]



[Drawing 5]



[Drawing 6]



[Translation done.]